Federal Aviation Administration

Transport Certification Update

Inside...
Composites and Lightning Strikes
and other articles

Edition 23 • Fall 2007

OK-07-324

Northwest Mountain Region, Federal Aviation Administration,
Department of Transportation

Transport Certification Update

Inside this issue:

Composites and Lightning Strikes 3

The New Path to Certification 7

Glass: Clearly a Safety Issue 10

Coming in Edition 24:

- Lessons Learned from Accidents
- Cargo Compartments
- Synthetic Vision

Contact Us:

If there is a topic you would like to read about, or if you have a question or comment, please e-mail us: 9-ANM-TAD-Update@faa.gov

From the Directorate Manager

Welcome to Edition 23 of the *Transport Certification Update*. As some of you will note, this is our first edition of the *Update* in several years. It's also our first to use an online format.

The *Update* began in 1982 as the *Designee Newsletter*. We changed the name in 1995 when we recognized that our work in the FAA's Transport Airplane Directorate (TAD) had become more global and we needed to get certification information to a much wider audience. The publication's hiatus since 1997 was due to resources being diverted to address an abundance of airworthiness directives.

The *Update* is intended not only for FAA designees, but also the aviation community at large, including aviation manufacturers and suppliers, industry representatives, and foreign aviation officials.

Readers have told us that there are few other sources for the type of information provided in the *Update*. And now with the ability to publish online, we hope to get information to you more quickly. This publication is one way we're improving communication with you, our customers, and keeping you informed of topics involving aircraft certification in the TAD. In this edition, we'll offer you a snapshot of the TAD and transport certification today, as well as the opportunity to tell us what you'd like to read about. In future editions, we'll bring you newsworthy items involving:

- Regulatory activities, changes, and philosophy
- Guidance material (Advisory Circulars, Orders, etc.)
- Specific technical issues (fatigue, damage tolerance, avionics, synthetic vision, etc.)
- Chief Scientists/Technical Advisors (CSTA) activity
- Designee responsibilities
- TAD activities
- Personnel actions/ changes
- Designee meetings (significant discussion issues, etc.)

We look forward to your comments on the *Update*. We want to publish articles that focus on your needs and interests, so we especially welcome ideas for topics you want to read about. With more accurate and timely information, we can provide the quality services you expect. The key is working together.

I hope you enjoy our newly renovated *Transport Certification Update*. ✈

At any given time there are 2,000 thunderstorms, generating an average of 100 lightning strikes per second around the globe. It is no surprise, then, that each commercial airplane sustains about one lightning strike per year.

From "Organizing Lightning," page 3

"It's like the Constitution; it doesn't give defined rules, but it gives parameters for going forward; it doesn't give you the answers, but it gives you the path," says Richard Boone, Co-Head of Engineering, … Adam Aircraft.

From "The New Path to Certification," page 7

...glass has, for centuries, been used for artistic and decorative purposes, and those who design custom airplane interiors often want to use glass for aesthetic reasons.

From "Glass: Clearly a Safety Issue," page 10

Features

Composites and Lightning Strikes Page 3

Composite aircraft raise new lightning safety and certification issues for the FAA and industry.
by Jill Byington
Dave Walen, Larry Ilcewicz, and Erv Dvorak contributed to this story.

The New Path to Certification Page 7

Partnership for Safety Plans are helping the FAA and its customers develop a successful relationship and are making the process of certifying aircraft more efficient in a complex world.
by Jill Byington
Melissa Sandow contributed to this story.

Glass: Clearly a Safety Issue Page 10

Applicants have requested to install various aesthetic glass fixtures in the airplane cabin for custom interiors.
by Jill Byington
Alan Sinclair contributed to this story.

Departments

From the Directorate Manager Page 1

Featured Web Site Page 12

Regulatory Radar Page 12

A Little Perspective Page 17

On the Web

Aircraft Certification (AIR) Web Site

AIR Draft Documents Open for Comment

Docket Management System

FAA Flight Plan Quarterly Report

Regulatory and Guidance Library

Transport Airplane Directorate Web Site

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Composites and Lightning Strikes

Composite aircraft raise new lightning safety and certification issues for the FAA and industry.

Some experts call lightning storms a "global electric circuit." At any given time there are 2,000 thunderstorms, generating an average of 100 lightning strikes per second around the globe. It is no surprise, then, that each commercial airplane sustains about one lightning strike per year.

In practical terms, that means when you step on an airplane there is a chance that you will hear the bang and see the flash of a lightning strike during the flight. That same airplane must meet all FAA regulations. Regulations concerning lightning strikes demand designs that make it very unlikely lightning will spark a fuel explosion, cause system upsets, or significantly damage structure.

Direct Effects of a Lightning Strike:

Burning and puncture at lightning attachment points, and arcing and sparking in the vicinity of attachment points.

Indirect Effects of a Lightning Strike:

High-voltage, current, and/or magnetic fields on avionics and electrical systems, hydraulic tubes, and flight control cables.

No transport airliner has crashed because of a lightning strike for over 30 years, which speaks to the manufacturers' and airlines' successful efforts to meet or exceed FAA regulations. However, this stellar safety record is with transport airplanes made substantially of aluminum. Aluminum conducts electricity very well – if no gaps exist in the conductive path, the lightning remains outside of the airplane.

The trend today, however, is toward building airplanes like the Boeing 787 and the Adam Aircraft A500 where a substantial part of the airframe — including the wing and fuselage — is made of composite materials. Airframe manufacturers are using composites to lower weight, improve structural strength, and to reduce operating and maintenance costs. Composites are poor conductors — they are 1,000 times more resistive than aluminum. The lightning-induced voltage produced between points on a composite aircraft is much higher than that on aluminum — on the order of a few thousand volts for a transport category airplane like the 787. This results in high current on wire bundles, fuel tubes, control cables and pushrods, and hydraulic tubes.

Lightning always attaches at more than one point.

Getting to "Very Unlikely"

Major structures of airplanes have been built with composites and flown safely for over 25 years. For example, Airbus Model A340 airplanes have carried fuel safely in a composite horizontal tail since 1991. That experience laid the groundwork for lightning certification of all-composite aircraft.

Lightning attaches to extremities — a golf club held aloft or the wingtips and similar points on an aircraft. When lightning attaches to an airplane, lightning current flows between the two or more attachment points at the airplane extremities, making the airplane part of the lightning channel. Since the airplane is moving relative to the lightning, the lightning effectively sweeps from the

Continued on page 4

"Lightning is something which, again, we would rather avoid."

~ Richard Branson, aviation entrepreneur

What is a Composite?

A composite is a material made of two or more distinct (that is, visible) materials. Familiar composites are concrete, fiberglass, and plywood. Composite materials such as carbon fiber reinforced plastics (CFRP) are used for many aircraft structures. These materials improve performance by saving weight.

Lightning…. Continued from page 3

front extremities toward the back of the airplane in what is called "swept lightning." Therefore, large areas of an airplane must be protected from both the direct and the indirect effects of lightning strikes.

Even without the use of composite structures, shielding an airplane from lightning and complying with lightning protection regulations is challenging. The best way to meet the safety requirements for composite aircraft is to address lightning certification and protection early in the design phase for three different areas: fuel systems, structure, and electrical/ avionics systems. These systems must be designed to reduce voltage, redirect current, or make the systems more tolerant.

Fuel Systems

Lightning protection is the most challenging aspect for composite structures with integral fuel tanks. The high lightning-induced voltages and currents that could be present in the fuel tanks and on the fuel system plumbing could cause sparks or other ignition sources. Solutions include preventing sparks by using a metal foil or mesh on the outside surface of the wing skins where fasteners join the wing skins to the underlying structure; sealing fasteners exposed to fuel tanks; electrical bonding between fuel tank plumbing and wing structure; and installing insulated brackets and fuel tubes. As a final measure of protection, fuel tanks in transport category airplanes may use a nitrogen generating system to fill the space above the fuel in the fuel tank with inert gas.

Structure

The aircraft structure provides the first layer of lightning protection for the crew, passengers, avionics, mechanical systems, and fuel systems. However, composite structures have less inherent lightning protection capability than aluminum when it comes to structural integrity. Where an aluminum structure could sustain a small pit (about 1/8 inch) at a lightning attachment point, but a composite structure without lightning protection might sustain 6 to 12 inches of damage.

Lightning protection has been achieved for many years for composite structures by adding metal foil, mesh, or wires to the outside surface of the thick composite laminate structure, by adding dedicated metal conductors (raceways, conduits, or bus bars), and by adding bonding straps across movable surfaces. This design conducts the lightning current and routes it safely through the added metal. Manufacturers of fuel tank structures for composite aircraft must ensure that the skin around the fuel tanks is thick enough to prevent lightning from puncturing the skin, and ensure that all structural joints and fasteners are installed tightly to prevent sparks. In addition, manufacturers often use a nonconductive sealant to prevent sparks and arcs from occurring inside the fuel tanks where wing skin fasteners and joints may have direct lightning attachment.

Electrical/Avionics Systems

Lightning protection for electrical and avionics systems is more complicated for an airplane with a composite structure, though the approaches to protection are well-known. Lightning seeks the metal paths available, and these paths — often associated with electrical and avionics systems — are far fewer on composite structures. Therefore, these systems must be designed to reduce voltage, redirect current, or to be more tolerant of the intense electromagnetic field generated during a lightning strike. Shielding ensures that systems such as flight displays, air data computers, inertial reference systems, and fly-by-wire systems are not disrupted in flight.

Materials on the 787

- Composites - 50%
- Aluminum - 20%
- Titanium - 15%
- Steel - 10%
- Other - 5%

Source: www.boeing.com

Link:
Still and video images of an airplane during a lightning strike.

Source: www.crh.noaa.gov/pub/ltg/plane_japan.php

Certification Guidance

Electricity is really just organized lightning.
~ George Carlin, comedian

George Carlin could also have said the opposite; that lightning is disorganized electricity. The FAA's lightning protection guidance is designed to help manufacturers organize lightning as it strikes the aircraft and channel it away where it will do no harm.

The FAA has three primary Advisory Circulars (AC) that provide guidance for approval of lightning protection for an aircraft. For more information, contact the aircraft certification office for your region.

Continued on page 5

Lightning…. Continued from page 4

1 AC 20-53B, Protection of Aircraft Fuel Systems against Fuel Vapor Ignition Caused by Lightning. This AC addresses how to protect the aircraft's fuel system from lightning strikes that may ignite fuel vapors. This AC also shows how to gain FAA approval of compliance with Title 14, Code of Federal Regulations (14 CFR) sections 23.954, 25.954, 27.954, and 29.954.

2 AC 20-136A, Protection of Aircraft Electrical/ Electronic Systems against the Indirect Effects of Lightning. This AC addresses hazards posed by the indirect effects of lightning to electrical and electronic systems and associated wiring installed on an aircraft. This AC shows a means for complying with the applicable sections of 14 CFR parts 23, 25, 27, 29, and 33 as they pertain to the type certificate or supplemental type certificate of an aircraft.

AC 20-136A also describes the following lightning-protection steps. For more information about these steps, see SAE document ARP5415 - User's Manual for Certification of Aircraft Electrical/Electronic Systems for the Indirect Effects of Lightning.

The lightning protection steps described in AC 20-136A are:

- Determine lightning attachment zones.
- Establish external lightning environment.
- Establish internal lightning environment.
- Identify systems and their locations.
- Establish system susceptibility.
- Design protection.
- Verify protection.

3 AC 20-155, Society of Automotive Engineers (SAE) Documents to Support Aircraft Lightning Protection Certification. This AC recommends two SAE International documents to help show compliance with the regulatory requirements of a type or supplemental type certification program. The first, SAE ARP5412A – Aircraft Lightning Environment and Related Test Waveforms, provides accepted definitions of lightning electrical characteristics for aircraft tests and analyses. The second, SAE ARP5414A – Aircraft Lightning Zoning, provides accepted definitions of the lightning attachment locations for aircraft. The documents supplement the engineering and operational judgment used to form the basis of any compliance findings on lightning protection.

Other Guidance: Standard Procedures and Environmental Test Criteria. Additional sources of guidance come from the Radio Technical Commission for Aeronautics (RTCA), which has standard procedures and environmental test criteria for testing airborne equipment. RTCA document DO-160E, Environmental Conditions and Test Procedures for Airborne Equipment, contains Section 22: Lightning Transient Susceptibility, and Section 23: Direct Lightning Effects.

When Lightning Strikes More than Twice

The reason lightning doesn't strike twice in the same place is that the same place isn't there the second time. ~ Willie Tyler, comedian

Frequent flyers know when they enter the global electric circuit that there is a chance they will hear the bang and see the flash of a lightning strike on the aircraft, and that the aircraft they fly on is likely to be struck many times during its life.

The certification requirements for any aircraft — with or without composite structures — are designed to ensure that the potential for a lightning-induced hazard to the passenger simply isn't "there" the first time, the second time, or the billionth. ✈

For more information, see page 6

Some experts call lightning storms a "global electric circuit."

Lightning… Continued from page 5

Safety and Certification Initiatives

The FAA has ongoing safety and certification initiatives related to composite structures. These initiatives relate to issues associated with increasing composite applications such as material control and standardization, structural substantiation, damage tolerance and maintenance practices, flammability, crashworthiness, and bonded joint processing.

The FAA participates with industry in the SAE AE2 Lightning Committee to develop standards for aircraft lightning protection, such as the SAE reports cited in this article.

RTCA, Incorporated is a not-for-profit corporation formed to advance the art and science of aviation and aviation electronic systems for the benefit of the public. RTCA functions as a Federal Advisory Committee and develops consensus-based recommendations on contemporary aviation issues. The organizations' recommendations are often used as the basis for government and private sector decisions as well as the foundation for many Federal Aviation Administration Technical Standard Orders. Sections 22 and 23 of RTC document DO-160 contain the standards for equipment lightning certification.

Carbon Fiber Composite Airplanes Must Comply With:

14 CFR 23.867, "Electrical bonding and protection against lightning and static electricity."

14 CFR 23.1309(e), "Equipment, systems and installation."

14 CFR 25.581, "Lightning protection."

14 CFR 25.981, "Fuel tank ignition prevention."

14 CFR 25.1316, "System lightning protection."

14 CFR 27.610, "Lightning and static electricity protection."

14 CFR 27.1309(d), "Equipment, systems and installation."

14 CFR 27.1309(h), "Equipment, systems and installation."

14 CFR 29.610, "Lightning and static electricity protection."

14 CFR XX.954, "Fuel system lightning protection."

14 CFR XX.1529, "Instructions for continued airworthiness.

NOTE: The "XX" designation includes CFR Parts 23, 25, 27, and 29.

Some Airplanes with Substantial Composite Structures:

Adam Aircraft A500

Airbus A330, A340, and A380

ATG Javelin

Boeing 787

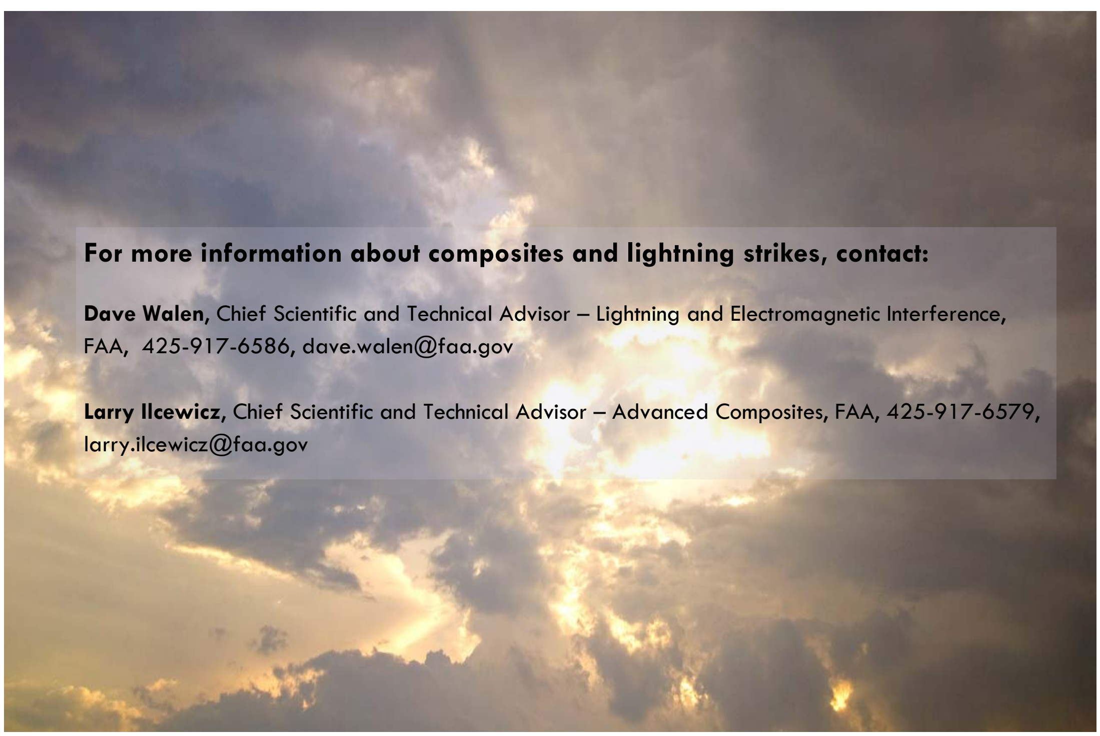
Grob spn

Hawker Horizon

Raytheon Beech Hawker

Premier I

Spectrum Independence



For more information about composites and lightning strikes, contact:

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The New Path to Certification

Partnership for Safety Plans are making the process of certifying aircraft more efficient in a more complex world.

"It's like the Constitution; it doesn't give defined rules, but it gives parameters for going forward; it doesn't give you the answers, but it gives you the path," says Richard Boone, Co-Head of Engineering, and 37th employee of Adam Aircraft, in Englewood, Colorado.

Boone was speaking of a Partnership for Safety Plan (PSP), which provides a means for the FAA and an applicant for certification to identify and resolve issues early in the certification process, to develop a successful relationship, and to certify a safe product using efficient, continuously improving processes. For Adam Aircraft, founded in 1998, this meant that it took only 3.5 years from the time of first contact with the FAA's Denver Aircraft Certification Office (ACO) to the issuance of the type certificate (TC) for its A500 airplane on May 11, 2005. According to Boone, the successful certification was due in large part to good relationships with and help from the people in the Denver ACO through a PSP.

Not Changing *What* We Do; Changing *How* We Do It

A PSP is a primary tool in the FAA's Certification Process Improvement (CPI). CPI is documented in The FAA and Industry Guide to Product Certification (the Guide), which was implemented in 1999 by FAA Notice 8110.80 and revised in September 2004. The guide provides a model for a PSP, and describes "how to plan, manage, and document an effective, efficient product certification process and working relationship between the FAA and an applicant." CPI differs from the original certification process through its use of up-front communication, and in developing a more successful relationship between the FAA and an applicant, yet still certifying safe products. The Notice states, "CPI is not a major overhaul of the current certification process. It does not change what we do; rather it changes how we do it."

The goal of CPI is to improve the certification process by establishing up front a clear understanding of the needs and expectations of both the applicant and the FAA. The Guide states that "reducing the cycle time to certify products, while ensuring regulatory compliance, will require earlier involvement of FAA and applicants in project planning, open and constructive communication, and safety-focused project management." The CPI principle of up-front planning applies to TCs, supplemental TCs (STCs), significant amendments to TCs and STCs, production approval, and other design approvals.

The Notice describes the need for improving the

Continued on page 8

With the help of a PSP, it took only 3.5 years for Adam Aircraft to receive a type certificate for its A500, a pressurized, twin-engine airplane with 21st-century design and carbon-fiber composite construction.

"We have the same goals, but PSP tells how we're going to achieve our common goals."

~ Beth Pasztor, Boeing Commercial Airplanes

Beth Pasztor credits the PSP with helping her to transition quickly into her new position as director of certification of regulatory affairs with Boeing Commercial Airplanes.

"...Our agreement says, 'You give us a plan and we (the FAA) will respond at a specified time, ... and we won't hold up the project because we've agreed to do it within that time.'"

~ Melissa Sandow, Denver ACO

New Path… continued from page 7

certification process. The improvement process began in 1995 when the FAA and the General Aviation Manufacturers Association (GAMA) met to enhance the certification process. It became clear to both the FAA and GAMA that there were process problems throughout the manufacturing industry, so in 1997 they expanded to include rotorcraft, engines, large transports, and more. In the end, the FAA, GAMA, and Aerospace Industries Association (AIA) comprised the CPI team and developed the CPI process.

What made an improvement in the certification process necessary? According to Notice 8110.80, several things: increasingly complex technologies, globalization of aviation manufacturing, and diminishing resources for the FAA and applicants.

Identifying certification problems early in the process decreases the applicant's risk. The Background to the Notice puts it like this: "Often, an applicant makes major design decisions and commitments before they submit an application for certification to the FAA. By then it could be too late to easily correct design problems identified by the FAA. Communication between the FAA and applicant during the design concept phase can help avoid costly changes."

Ensuring Continuity

For a newer company like Adam Aircraft, the PSP is ingrained as part of the certification process — the only way they've done business with the FAA. For more established companies, a PSP can be a foundation to moving forward in a more complex world, with a rapidly changing workforce.

Beth Pasztor, Chief Engineer, Airplane Systems, Technology, and Product Development for Boeing Commercial Airplanes says, "PSP was a very natural transition; it formalized the way we've always done business. We were continuously improving naturally, but now it's in writing. It saves time and effort if it's formalized, and it especially helps when you start including new people in the process."

Pasztor points to herself as a perfect example of making a transition into the established PSP certification process. She says that there were many initiatives in work when she started her position in January of 2005. But the PSP was already in place, so she could sit down, get a quick overview, and pick up efficiently where her predecessor left off. "The beauty of people moving around," says Pasztor, "is that they can carry the expertise and the message with them to other projects."

As with all companies, Boeing is always driving toward continuous improvement, looking for new ways to work lean, and trying to find the key to getting to the next level of engagement. Their means for doing this is a positive relationship with the FAA's Transport Airplane Directorate and Seattle ACO. Pasztor characterizes Boeing's certification relationship with the FAA as mutual, with a spirit of working together. She states that this relationship has always been there, but the PSP "brought it home in a deliberate manner. We have the same goals, but PSP tells how we're going to achieve our common goals."

Defining and Meeting Expectations

For Melissa Sandow, certification through a PSP all boils down to everyone knowing what they're supposed to do, and doing what they've agreed to do. Sandow was Senior Engineer and Small Airplane Program Manager at the Denver ACO during the A500 certification process. She also has worked with other companies,

Continued on page 9

New Path…. Continued from page 8

including Goodrich Aircraft Interior Products (AIP). Sandow says of the Goodrich AIP PSP, "In that case our agreement says, 'You give us a plan and we (the FAA) will respond at a specified time, say in two weeks, and we won't hold up the project because we've agreed to do it within that time.' Their schedule is significantly reduced for FAA involvement.

Then after that we can turn around an approval for a seat within a day because they did what they agreed to do, and we did what we agreed to do. We have a trust we've built with them so we can get them their approvals, and they can satisfy their customers more quickly. They can count on it."

The working principle in the Denver ACO is to establish a foundation to start from so the certification process is shorter. With goals and expectations defined up front, Sandow says, "Nobody's guessing and the process isn't dragged out. We've established expectations and accountability."

Continuous Improvement

The PSP works well in some companies, but the FAA conducted a survey in 2005 that showed some customers weren't seeing the expected benefits. In some cases, the principles of the PSP are simply being complied with as another mandated requirement.

Many companies surveyed said that the PSP tremendously improved communication with the FAA. They saw a shift from a "directed-type" approach to a "collaborative-type" role; they said the level and quality of communication is exceptional and response is timely. They found the FAA to be understanding of industry demands.

Still, others did not find improvements in working relationships with the FAA, and noted problems negotiating the "massive FAA bureaucracy," inconsistent communication, and unclear guidance. Many stated that good communication is the key and "can't be stressed enough."

The FAA team members who compiled the results of the survey concluded: "Customers who generally possessed collaborative relationships with the FAA agreed that PSPs provided value. They believed that PSPs enhanced communications between the FAA and themselves and facilitated consistency among certification programs. Customers with structured internal processes may have reported limited value in PSPs and may not realize the full benefits until transitional periods occur during FAA project team changes."

The FAA team recommended meeting with customers before initiating PSP actions to understand their concerns and needs; making sure that FAA personnel fully understand CPI principles; engaging directly in a customer's internal CPI discussions; and ensuring that lessons learned are fully documented so new staff members don't "re-plow old ground."

Breaking Ground for the Future

At Adam Aircraft, Boeing, and Goodrich AIP, and for many other applicants, the PSP is an ingrained part of the certification process. Richard Boone of Adam Aircraft says that the PSP is the top-level document that drives all other processes and documentation. "Everyone is aware of it; it's the first place people go to resolve requirements and obligations. It's our basis for relating to the ACO."

Boone notes that the PSP and the Denver ACO have helped Adam Aircraft do things that have never been done before. "They empower us to make decisions and break away from restraints, with the guidance for doing that. The ACO knows that they have limited resources, and they need to guide us in how to handle things on our own. We're growing fast and we plan to be around for a lot more certification programs."

"They empower us to make decisions and break away from restraints, with the guidance for doing that. The ACO knows that they have limited resources, and they need to guide us in how to handle things on our own."

—Richard Boone, Adam Aircraft

For Adam Aircraft, growing in the future means that the ACO they work with also has to adapt. "They'll have to do a lot of groundbreaking," Mr. Boone notes in reference to certifying Adam Aircraft's all-composite and very light jet business airplanes. "The best thing we can do with the ACO is to communicate well, but we're really lucky that we have a good relationship." ✈

Glass: Clearly a Safety Issue

Sometimes it's easy to see right through a safety problem.

Those of us who have bumped against a hard glass object can easily forget that glass is, in essence, an amorphous, highly viscous, liquid. It can chip, crack, and fracture; it breaks into sharp fragments that can cause injury or be lethal; it is also heavy and highly variable in its properties – glass panels that have stood up predictably to the most stringent safety checks time after time can shatter at seemingly random moments. In fact, even airplane windshields, where glass has always been used, can shatter and injure pilots.

Glass has one unique characteristic – transparency, also called "undistorted or controlled light transmittance" – that makes it desirable for more than just the functional purposes allowed by existing airworthiness standards. Transparency means that glass has, for centuries, been used for artistic and decorative purposes, and those who design custom airplane interiors often want to use glass for aesthetic reasons.

Case-by-case Considerations

Applicants have requested to install various aesthetic glass fixtures in the airplane cabin for custom interiors: Glass shower stalls, wall-mounted mirrors, glass doors, glass panels on the ceiling, and decorative glass dividers.

One proposed glass divider was one inch thick, weighed 300 pounds and had only three attachment points. The FAA also once received a request to install a glass dance floor in the center cabin. The proposed floor was not attached to the interior and proved to be susceptible to shattering beneath high heels.

The requests to install the glass dance floor and the 300-pound divider were denied. However, FAA experts such as Cabin Safety Specialist Alan Sinclair, consider each request on its individual merits.

Recently, the FAA provided standards for the use of decorative/structural glass on a private jet as follows:

Large glass items (more than 4 kilograms (kg) in mass) may be installed only in rooms or areas in the cabin that are not occupied during taxi, takeoff, and landing; and are not part of a pathway for an emergency exit.

Small glass items (less than 4 kg in mass, or groups of items weighing less than 4 kg in mass) may be installed in rooms or areas in the cabin that are occupied during taxi, takeoff, and landing; and not part of a pathway for an emergency exit.

Glass items that are integrated into a device that depends on glass to operate, such as instrument transparencies or monitor screens, may be installed in any area in the cabin regardless of occupancy. These items have a protective polycarbonate layer that covers the exposed glass.

These standards are designed to ensure that the potential for injury is highly localized (such as glass instrument faces) or highly unlikely (such as lavatory mirrors). All of these glass items are subject to the limits in 14CFR 25.775, and must be "designed to give each occupant every reasonable chance of escaping serious injury in a minor crash."

Existing Standards

The existing airworthiness standards do not contain adequate or appropriate safety standards for large non-structural glass installations in the cabin area of executive interiors that are occupied by passengers and crewmembers during flight. Therefore, for each non-standard installation, the FAA considers the request and, if feasible, issues a Special Condition. Special conditions contain the additional safety standards necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

Special Condition (SC) No. 25-311-SC (71 FR 1485, January 10, 2006) was issued for a specific Boeing Model 747-400 airplane. This SC addresses novel and unusual installations of large non-structural glass items that include, but are not limited to, glass partitions, glass attached to the ceiling, and wall or door mounted mirrors or glass panels. The FAA approved these installations as long as they meet certain conditions, as follows:

Continued on page 11

Glass…. Continued from page 10

- The airplane may not be operated for hire or offered for commercial carriage.
- The glass used must be tempered or treated to ensure that when fractured it breaks into small pieces with relatively dull edges; and that when tested the fragmentation must be controlled to reduce the danger from flying glass shards.
- The glass must be strong enough to meet load requirements for all flight and landing loads, including applicable emergency landing conditions; "abuse" loading (sitting, leaning, and other forceful contact); and meet structural testing.
- The glass must not come free from its restraint or mounting system in the event of an emergency landing.
- The *Instructions for Continued Airworthiness* must reflect the fastening method, including the life limit of adhesives or clamps, and inspection intervals for the installation.

A Transparent Future?

Although glass as we know it will always remain a safety issue on airplanes, the future is likely to bring changes in the structure of transparent materials. For example, we are likely soon to see glass on airplanes that changes from clear to opaque with the application of an electric current. Not too long ago that kind of glass would have been the stuff of science fiction.

The next steps could be transparent metal, a structure that is much more predictable than glass, or perhaps even plastics that better mimic glass's pure transparency. ✈

For more information about glass in the airplane cabin, contact:

Alan Sinclair, Cabin Safety Specialist,
425-227-2195,
Alan.Sinclair@faa.gov

Federal Aviation Regulation Part 25, Section 775, "Windshields and windows"

(a) Internal panes must be made of nonsplintering material.
(b) Windshield panes directly in front of the pilots in the normal conduct of their duties, and the supporting structures for these panes, must withstand, without penetration, the impact of a four-pound bird when the velocity of the airplane (relative to the bird along the airplane's flight path) is equal to the value of V_C, at sea level, selected under Sec. 25.335(a).
(c) Unless it can be shown by analysis or tests that the probability of occurrence of a critical windshield fragmentation condition is of a low order, the airplane must have a means to minimize the danger to the pilots from flying windshield fragments due to bird impact. This must be shown for each transparent pane in the cockpit that—
(1) Appears in the front views of the airplane;
(2) Is inclined 15 degrees or more to the longitudinal axis of the airplane; and
(3) Has any part of the pane located where its fragmentation will constitute a hazard to the pilots.
(d) The design of windshields and windows in pressurized airplanes must be based on factors peculiar to high altitude operation, including the effects of continuous and cyclic pressurization loadings, the inherent characteristics of the material used, and the effects of temperatures and temperature differentials. The windshield and window panels must be capable of withstanding the maximum cabin pressure differential loads combined with critical aerodynamic pressure and temperature effects after any single failure in the installation or associated systems. It may be assumed that, after a single failure that is obvious to the flight crew (established under Sec. 25.1523), the cabin pressure differential is reduced from the maximum, in accordance with appropriate operating limitations, to allow continued safe flight of the airplane with a cabin pressure altitude of not more than 15,000 feet.
[(e) The windshield panels in front of the pilot must be arranged so that, assuming the loss of vision through any one panel, one or more panels remain available for use by a pilot seated at a pilot station to permit continued safe flight and landing.]

Amendment 25-38, Effective 2/1/77

TAD Regulatory Radar

Current Rulemaking

The following rulemaking actions have been published in the *Federal Register* as of the end of May 2007. For full text of these and other actions see: http://dms.dot.gov.

Final Rules:

Extended Operations (ETOPS) of Multi-engine Airplanes. Docket No. FAA-2002-6717; Final Rule (FR) issued 1/16/07. Amendment Nos. 1-55, 21-89, 25-120, 33-21, 121-329, 135-108.

This rulemaking project was led by Flight Standards with participation from the TAD and the Seattle ACO. Extended operations, or ETOPS, for long-range international travel provide savings in time and fuel, and operational efficiencies. However, when one travels great distances from airports, the safety of these operations depends on certain risks, such as critical loss of engine thrust, system failures during a diversion, etc. This rule codifies and expands existing FAA ETOPS policy and route authorizations for all part 121 two-engine airplanes, and extends most requirements previously applicable only to part 121 two-engine airplanes to a limited number of part 121 passenger-carrying three- and four-engine airplane operations and applies the same limitations to comparable part 135 operations.

Fire Penetration Resistance of Thermal Acoustic Insulation. Docket No. FAA-2006-24277; FR issued on 1/4/07. Amendment No. 121-330.

This FR extends by 12 months the date for operators to comply with the fire penetration resistance requirements of thermal/acoustic insulation used in transport category airplanes manufactured after 9/2/07. This extension is from 9/2/07 to 9/2/08. This action is necessary to allow manufacturers enough time, after getting an acceptable certification test facility, to select and certificate appropriate installations.

Notices of Proposed Rulemaking (NPRM)

Activation of Ice Protection. Docket No. FAA-2007-27654. Notice No. 07-07. NPRM published 4/26/07. Comments due 7/25/07.

The FAA proposes to amend the airworthiness standards applicable to transport category airplanes certificated for flight in icing conditions. The proposed standards would require a means to ensure timely

Continued on page 13

Featured Web Site: Aircraft Certification Draft Documents Open for Comment

Aircraft Certification (AIR) maintains a web site on the Internet at http://www.faa.gov/aircraft/draft_docs/ that solicits comments on draft Advisory Circulars (ACs) published both by AIR and Flight Standards; orders; notices; policy statements; technical standard orders (TSOs); and publications.

Each document contains a summary of the document, a link to the draft document, instructions about how to comment, the comment due date, and contact information. On the main page of the web site, you may subscribe to receive an e-mail notification whenever new documents are issued for comments.

AIR no longer publishes individual notices of the availability of these draft documents in the *Federal Register*, and does not maintain the drafts in the Regulatory and Guidance Library (http://rgl.faa.gov). AIR publishes a monthly reminder of the web site in the *Federal Register*.

Reg. Radar/Rulemaking…. Continued from page 12

activation of the airframe ice protection system. This proposed regulation is the result of information gathered from a review of icing accidents and incidents, and is intended to improve the level of safety for new airplane designs for operations in icing conditions.

Security Related Considerations in the Design and Operation of Transport Category Airplanes (ICAO Annex 8, Amdt 97). Docket No. FAA-2006-26722; Notice No. 06-19. NPRM published on 1/5/07; Comment period ended 4/5/07.

The FAA proposes to implement certain security related requirements governing the design of transport category airplanes. The requirements would provide improved airplane design features and greater protection of the cabin, flightdeck, and cargo compartment.

Widespread Fatigue Damage (WFD). Docket No. FAA-2006-24281; Notice No. 06-04. NPRM published 4/18/06. Comment period extension published 7/7/06. Comment period ended 9/18/06.

The NPRM is intended to prevent WFD by proposing to require that design approval holders (DAH) establish operational limits on transport category airplanes. DAHs would also be required to determine if maintenance actions are needed to prevent WFD before an airplane reaches its operational limit. Operators of any affected airplanes would be required to incorporate the operational limit and any necessary service information into their maintenance programs. Operation of an affected airplane beyond the operational limit would be prohibited, unless an operator has incorporated an extended operational limit and any necessary service information into its maintenance program.

Damage Tolerance Data for Repairs and Alterations. Docket No. FAA-2005-21693; Notice No. 05-11. NPRM published 4/21/06. Comment period extension published 7/7/06. Comment period ended 9/18/06.

This NPRM would require DAHs to make available to operators damage tolerance (DT) data for repairs and alterations to fatigue critical structure. This proposal is needed to support operator compliance with the requirement to include DT inspections and procedures in their maintenance programs, and to enable operators to take into account the possible adverse effects of repairs and alterations on fatigue critical structure. The intended effect of this proposal is to ensure the continued airworthiness of fatigue critical airplane structure by requiring DAHs to support operator compliance with specified DT requirements.

Advisory Circulars (ACs) and Policy

The following projects related to ACs and Policies are currently underway in the TAD. For full text see: http://rgl.faa.gov

Part 25 Final Advisory Circulars (AC) issued:

AC 25.1329-1B: Approval of Flight Guidance Systems.

Issued final on **7/17/06.** This advisory circular (AC) describes an acceptable means for showing compliance with certain requirements of § 25.1329, Flight guidance systems. While part 25 contains the airworthiness standards applicable to transport category airplanes, the guidance in this AC pertains to the functions of autopilots, flight directors (FD), and automatic thrust control as well as any interactions with stability augmentation and trim functions.

AC 25-11-A: Electronic Flight Deck Displays.

Issued final on **6/21/07.** This AC provides guidance for showing compliance with certain requirements of part 25 for the design, installation, integration, and approval of electronic flight deck displays, components, and systems installed in transport category airplanes.

Part 25 Final Policies issued:

Installation of Transport Category Airplane Flightdeck Liquid Crystal Displays.

ANM-03-111-18, issued **8/9/06.** This memorandum clarifies FAA certification policy on the installation of liquid crystal displays (LCD) for use in the flightdeck of transport category airplanes.

Policy Statement on acceptance of SAE International Aerospace Recommended Practice (ARP) 5577 as an acceptable method of compliance to the Lightning Direct Effects requirements of § 25.581.

ANM-111-05-004, issued 4/4/06. This memorandum recognizes SAE International ARP 5577 as an acceptable method of compliance to the lightning direct effects requirements of § 25.581.

Interim Policy on High Altitude Cabin Decompression (Reference Amendment 25-87).

ANM-03-112-16, issued 3/24/06. For airplanes with wing-mounted engines, § 25.841(a), as amended by Amendment 25.87, this policy effectively limits the maximum operating altitude of airplanes approved to this standard to 40,000 feet. Design approval holders must petition for exemption.

Policy Statement on Modifications which Impact Airplane Exterior Lighting.

ANM-111-06-001, issued 5/14/07. This policy

Continued on page 14

Reg. Radar/ACs… continued from page 13

emphasizes the effects of airplane modifications, especially external antenna installations, on exterior lighting systems.

Part 25 Draft ACs issued:

AC 120-XX, Damage Tolerance Inspections for Repairs and Alterations.

Published for comment on 2/15/07; Comment period closed 4/20/07. (First version published for comment was only for repairs.) This AC sets forth an acceptable means, but not the only means, of demonstrating compliance with the provisions of the airworthiness standards for transport category airplanes related to damage tolerance inspections for repairs and alterations.

A variety of advisory circulars accompanying the "Security Related Considerations in the Design and Operation of Transport Category Airplanes" NPRM, as follows:

- AC 25.795-1X: Flightdeck Intrusion Resistance
- AC 25.795-2X: Flightdeck Intrusion Resistance
- AC 25.795-3X: Flightdeck Protection (Smoke and Fumes)
- AC 25.795-4X: Passenger Cabin Smoke Evacuation
- AC 25.795-5X: Compartment Fire Suppression
- AC 25.795-6X: Least Risk Bomb Location (LRBL)
- AC 25.795-7X: Survivability of Systems
- AC 25.795-8X: Design for Ease of Search

Published for comment on 1/5/07; Comment period closed 4/5/07.

AC 25.571-1X: Damage Tolerance and Fatigue Evaluation of Structure.

Published for comment on 8/18/06; Comment period closed 10/21/06. This draft AC contains proposed revisions to AC 25.571-1C. It provides guidance for compliance with § 25.571, pertaining to requirements for damage-tolerance and fatigue evaluation of transport category aircraft structure. It also includes guidance pertaining to discrete source damage.

Proposed Advisory Circular 120-XX, Damage Tolerance Inspections for Repairs.

Published for comment on 7/7/06; Comment period closed 9/18/06. This AC sets forth an acceptable means, but not the only means, of demonstrating compliance with the provisions of the airworthiness standards for transport category airplanes related to damage tolerance inspections for repairs.

AC 120-YY: Widespread Fatigue Damage on Metallic Structure.

Published for comment on 5/12/06; Comment period closed 9/18/06. This AC provides guidance to design approval holders on establishing operational limits (initial operational limits and extended operational limits) to preclude widespread fatigue damage for certain transport category airplanes.

Part 25 Draft Policy issued:

Certification of Video Monitors with Glass Screens.

Published for comment on 3/12/07; Comment period closed 4/11/07. This is an FAA policy on the certification of video monitors with glass screens. This proposed policy also addresses the gas used in gas plasma video monitors. This proposed policy provides a means to reduce the regulatory burden for video monitor certification by recognizing the nonhazardous and reliable nature of the smaller video systems.

Policy Statement on Minimizing Potential Injury Hazards of Deployment Mechanisms.

Published for comment on 7/31/06; Comment period closed 8/29/06. This proposed policy provides proposed guidance for evaluating the designs of deployment mechanisms installed in the airplane cabin.

Interim Guidelines for Certification and Continued Airworthiness of Unbalanced Control Surfaces with Freeplay and Other Nonlinear Features.

Published for comment on 4/20/06; Comment period closed 5/25/06. This policy clarifies FAA interim guidelines for the design, certification, and continued airworthiness of control surfaces that rely on retention of restraint stiffness for flutter prevention. ✈

Continued on page 15

Reg. Radar… continued from page 14

Airworthiness Directives (ADs)

The TAD issued 531 AD actions in fiscal year 2006. Full text of ADs is available at http://dms.dot.gov. The following is a description of a significant series of ADs.

Special Federal Aviation Regulation No. 88 (SFAR 88) ADs

The FAA has examined the underlying safety issues involved in fuel tank explosions on several large transport airplanes, including the adequacy of existing regulations, the service history of airplanes subject to those regulations, and existing maintenance practices for fuel tank systems. As a result of those findings, we issued a regulation titled "Transport Airplane Fuel Tank System Design Review, Flammability Reduction and Maintenance and Inspection Requirements" (66 FR 23086, May 7, 2001). In addition to new airworthiness standards for transport airplanes and new maintenance requirements, this rule included Special Federal Aviation Regulation No. 88 ("SFAR 88," Amendment 21‑78, and subsequent Amendments 21-82 and 21-83).

Among other actions, SFAR 88 requires certain type design (i.e., type certificate (TC) and supplemental type certificate (STC)) holders to substantiate that their fuel tank systems can prevent ignition sources in the fuel tanks. This requirement applies to type design holders for large turbine-powered transport airplanes and for subsequent modifications to those airplanes. It requires them to perform design reviews and to develop design changes and maintenance procedures if their designs do not meet the new fuel tank safety standards. As explained in the preamble to the rule, we intended to adopt airworthiness directives to mandate any changes found necessary to address unsafe conditions identified as a result of these reviews.

In evaluating these design reviews, we have established four criteria intended to define the unsafe conditions associated with fuel tank systems that require corrective actions. The percentage of operating time during which fuel tanks are exposed to flammable conditions is one of these criteria. The other three criteria address the failure types under evaluation: single failures, single failures in combination with a latent condition(s), and in-service failure experience. For all four criteria, the evaluations included consideration of previous actions taken that may mitigate the need for further action.

The Joint Aviation Authorities (JAA) has issued a regulation that is similar to SFAR 88. (The JAA is an associated body of the European Civil Aviation Conference (ECAC) representing the civil aviation regulatory authorities of a number of European States who have agreed to cooperate in developing and implementing common safety regulatory standards and procedures.) Under this regulation, the JAA stated that all members of the ECAC that hold type certificates for transport category airplanes are required to conduct a design review against explosion risks.

The actions identified in SFAR 88 ADs are necessary to reduce the potential of ignition sources inside fuel tanks, which, in combination with flammable fuel vapors, could result in fuel tank explosions and consequent loss of the airplane.

SFAR 88 ADs Issued from January through May 2007

AD 2007-03-10, amendment 39-14921 (72 FR 5160, February 5, 2007) for Airbus Model A300 airplanes; A300 B4- 600, B4-600R, and F4-600R series airplanes, and Model A300 C4-605R Variant F airplanes (Collectively Called A300-600 series airplanes); and Model A310 airplanes. This AD requires improving the routing of certain electrical wire bundles in certain airplane zones.

AD 2007-02-14, amendment 39-14901 (72 FR 3359) for Boeing Model 737-600, -700, -700C, - 800, and -900 series airplanes. This AD requires testing the electrical resistance of the bond between the bulkhead fitting for the fuel feed line and the front spar of the left and right wings, inspecting an adjacent bonding jumper to make sure it is installed correctly, and performing corrective and other specified actions, as applicable.

AD 2007-02-15, amendment 39-14902 (72 FR 3350) for Empresa Brasileira de Aeronautica S.A. (EMBRAER) Model ERJ 170 airplanes. This AD requires replacement of certain electrical bonding clamps and attaching hardware with new or serviceable parts, as applicable, and other specified actions.

AD 2007-05-06, amendment 39-14967 (72 FR 9652, March 5, 2007) for McDonnell Douglas Model 717-200 airplanes. This AD requires

Continued on page 16

ADs… continued from page 15

replacing certain attaching hardware of the bulkhead nipple assemblies of the left and right wing vent boxes with new electrical bonding attaching hardware, doing resistance testing of the new electrical bonds, and doing fuel leakage testing of the reworked nipple assemblies.

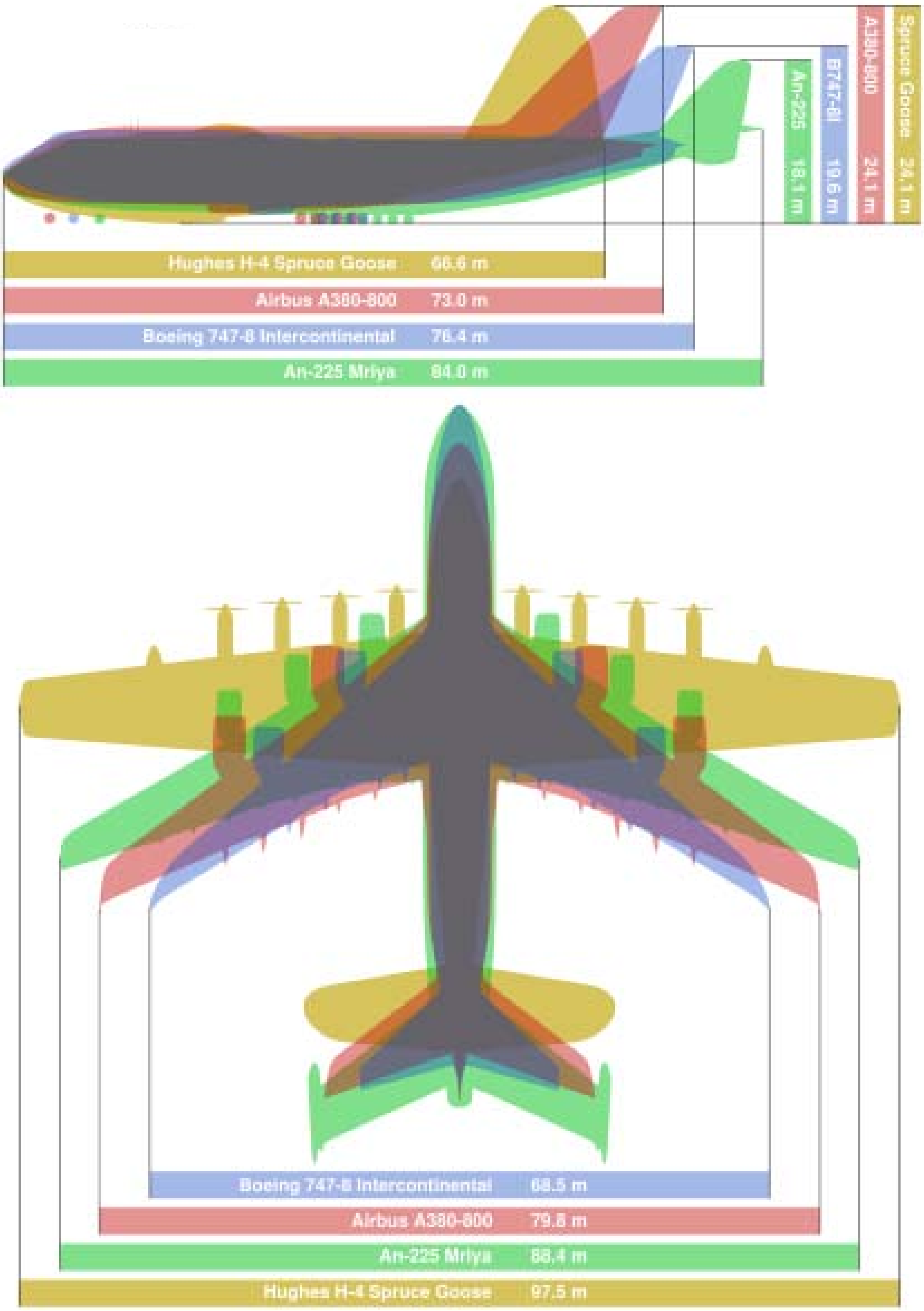
AD 2007-07-09, amendment 39-15006 (72 FR 15812, April 3, 2007) for Airbus Model A318, A319, A320, and A321 airplanes. This AD supersedes an existing AD that applies to certain Airbus Model A318-100, A319-100, A320- 200, A321-100, and A321-200 series airplanes; and Model A320-111 airplanes. This AD requires modification of the electrical bonding of all structures and systems installed inside the center fuel tank.

AD 2007-07-14, amendment 39-15015 (72 FR 16701, April 5, 2007) for EMBRAER Model EMB-135BJ airplanes. This AD requires modifying the forward and aft auxiliary fuel tanks. This AD results from a fuel system reassessment according to SFAR 88 criteria, which revealed the possibility of sparks due to chafing between the harnesses of the forward and aft auxiliary fuel tanks, between certain harnesses attached to the aircraft structure, or between certain harnesses attached to certain mechanical components.

AD 2007-10-10, amendment 39-15051 (72 FR 28827, May 23, 2007) for Airbus Model A300-600 series airplanes. This AD requires revising the Airworthiness Limitations section of the Instructions for Continued Airworthiness to incorporate new limitations for fuel tank systems.

AD 2007-11-14, amendment 39-15071 (72 FR 29879, May 30, 2007) for EMBRAER Model EMB-135BJ airplanes. This AD requires replacing the fuel level control unit (LCU) 1 and LCU 2; reworking the LCU 1 and LCU 2 supports; and segregating, replacing, and reworking some harnesses. ✈

The links in the *Transport Certification Update* are current at the time of publication, but they are subject to change at any time. The target documents may be moved to another location, or the links may not remain active due to other factors beyond our control. We regret any inconvenience this may cause.



U.S. Department
of Transportation
**Federal Aviation
Administration**

Transport Airplane Directorate
1601 Lind Avenue SW
Renton, WA 98057
Produced by:

Airworthiness and Technical Communications Branch, ANM-114,
Transport Airplane Directorate

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What is the Largest Airplane Ever Built?

The overlay diagram on the left shows four of the largest airplanes ever built, the Hughes H-4 Spruce Goose (aircraft with the greatest wingspan), the Antonov An-225 Mriya (the largest freight aircraft), the Airbus A380-800 (the largest passenger airplane), and the Boeing 747-8 Intercontinental (soon to be the largest version of the Boeing 747 Jumbo jet).